

WHAT IS CLAIMED IS:

1. A printing head where an electrothermal transducer for generating thermal energy used for discharging ink  
5 and a driver for driving said electrothermal transducer are provided on a substrate, comprising:

a sensor which detects the condition of said substrate and outputs an analog signal; and

10 an A/D converter which converts the analog signal from said sensor into a digital value,

wherein said sensor and said A/D converter are provided on said substrate.

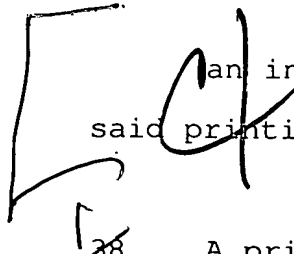
2. The printing head according to claim 1, wherein  
15 said driver includes:

a power transistor which drives said electrothermal transducer;

a shift register in which print data to drive said power transistor is temporarily stored; and

20 a latch circuit which latches the print data stored in said shift register.

3. The printing head according to claim 2, wherein the condition of said substrate includes at least one of  
25 temperature of said substrate, a resistance value of

 an ink tank which contains ink to be supplied to  
said printing head.

38. A printing head which outputs temperature  
5 information in accordance with input of print data,  
comprising:

a shift register which inputs print data in  
accordance with a first-frequency clock;

a heater which is energized and generates heat in  
10 accordance with said print data;

a temperature detector which detects an internal  
temperature of said printing head; and

a frequency divider which divides a frequency of  
said first-frequency clock and generates a second-  
15 frequency clock,

wherein said temperature detector outputs a signal  
indicative of a detected temperature in accordance with  
said second-frequency clock.

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20 ~~39~~. The printing head according to claim ~~38~~<sup>1</sup>, wherein  
said temperature detector has:

a temperature sensor;

a reference voltage generator which generates a  
reference voltage;

a switching circuit which changes said reference voltage in accordance with said second-frequency clock; and

a comparator which compares an output voltage from  
5 said temperature sensor with said reference voltage from said switching circuit, and outputs the result of comparison as a signal indicative of said detected temperature.

10 <sup>3</sup>  
~~40~~. The printing head according to claim <sup>1</sup>~~38~~, wherein said frequency divider divides the frequency of said first-frequency clock by two.

15 <sup>4</sup>  
~~41~~. The printing head according to claim <sup>1</sup>~~38~~, further comprising a latch circuit which latches print data stored in said shift register.

20 <sup>5</sup>  
~~42~~. The printing head according to claim <sup>1</sup>~~38~~, wherein said printing head is an ink-jet printing head which performs printing by discharging ink.

25 <sup>6</sup>  
~~43~~. The printing head according to claim <sup>5</sup>~~42~~, wherein said ink-jet printing head discharges ink by utilizing thermal energy, and includes a thermal energy transducer for generating the thermal energy to be applied to the ink.

7.  
44. A printing apparatus using the printing head in  
claim 38.

8.  
5 45. A head cartridge comprising:  
the printing head in claim 38; and  
an ink tank which contains ink to be supplied to  
said printing head.

~~Abstract~~  
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said electrothermal transducer and an ON resistance value of said power transistor.

4. The printing head according to claim 3, wherein  
5 said sensor has a p-n junction diode having a known temperature characteristic for detecting the temperature of said substrate, a resistor of the same material as that of said electrothermal transducer, formed by the same process as that of said electrothermal transducer,  
10 for detecting the resistance value of said electrothermal transducer, and a transistor of the same conduction type of that of said power transistor, formed by the same process as that of said power transistor,  
for detecting the ON resistance value of said power  
15 transistor.

5. The printing head according to claim 4, further comprising a nonvolatile memory for storing digital information indicative of the resistance value of said  
20 electrothermal transducer and digital information indicative of the ON resistance value of said power transistor, on said substrate.

6. The printing head according to claim 5, wherein  
25 said nonvolatile memory includes at least one of an EPROM, an EEPROM and a fuse ROM.

7. The printing head according to claim 5, wherein  
the digital information indicative of the resistance  
value of said electrothermal transducer and the digital  
5 information indicative of the ON resistance value of  
said power transistor, stored in said nonvolatile memory,  
were obtained by factory-shipment measurement.

8. A printing apparatus which performs printing by  
10 using the printing head in claim 1, comprising control  
means for receiving information outputted from said  
sensor and converted into a digital value, and  
performing drive control on said printing head based on  
said digital information.

15 9. A head cartridge comprising:  
the printing head in claim 1; and  
an ink tank which contains ink to be supplied to  
said printing head.

20 10. A printing head substrate having an electrothermal  
transducer for generating thermal energy used for  
discharging ink and a driver for driving said  
electrothermal transducer, comprising:  
25 a sensor which detects the condition of said  
substrate and outputs an analog signal; and

an A/D converter which converts the analog signal from said sensor into a digital value,

wherein said sensor and said A/D converter are provided on said substrate.

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11. The printing head substrate according to claim 10, wherein said driver includes:

a power transistor which drives said electrothermal transducer;

10 a shift register in which print data to drive said power transistor is temporarily stored; and

a latch circuit which latches the print data stored in said shift register.

15 12. The printing head substrate according to claim 11, wherein the condition of said substrate includes at least one of temperature of said substrate, a resistance value of said electrothermal transducer and an ON resistance value of said power transistor.

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13. The printing head substrate according to claim 12, wherein said sensor has a p-n junction diode having a known temperature characteristic for detecting the temperature of said substrate, a resistor of the same material as that of said electrothermal transducer, 25 formed by the same process as that of said

electrothermal transducer, for detecting the resistance value of said electrothermal transducer, and a transistor of the same conduction type of that of said power transistor, formed by the same process as that of said power transistor, for detecting the ON resistance value of said power transistor.

14. The printing head substrate according to claim 13, further comprising a nonvolatile memory for storing digital information indicative of the resistance value of said electrothermal transducer and digital information indicative of the ON resistance value of said power transistor, on said substrate.

15. The printing head substrate according to claim 14, wherein said nonvolatile memory includes at least one of an EPROM, an EEPROM and a fuse ROM.

16. The printing head substrate according to claim 14, wherein the digital information indicative of the resistance value of said electrothermal transducer and the digital information indicative of the ON resistance value of said power transistor, stored in said nonvolatile memory, were obtained by factory-shipment measurement.



17. A printing head which performs printing by discharging ink in accordance with an ink-jet method, comprising:

5 a memory for storing printing characteristics of a plurality of printing elements for discharging ink;

a converter which converts an analog signal into digital signal and outputs the digital signal; and

a driver which drives said plurality of printing elements in accordance with an input print signal,

10 wherein the printing characteristics are read from said memory by using a clock signal and a latch signal for inputting said print signal,

and wherein the digital signal is outputted from said converter by using said clock signal.

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18. The printing head according to claim 17, wherein each of said plurality of printing elements driven by said driver comprises:

a heater;

20 a switch which ON/OFF controls energization of said heater; and

a discharge nozzle which discharges ink heated by heat generation by said heater.

25 19. The printing head according to claim 18, wherein said driver has a shift register and a latch circuit.

20. The printing head according to claim 19, wherein  
said driver has:

5 a first input pad which inputs a heat pulse signal  
with respect to said heater;

a second input pad which inputs a print signal  
into said shift register;

a third input pad which inputs said clock signal;  
and

10 a fourth input pad which inputs a latch signal  
with respect to said latch circuit.

21. The printing head according to claim 20, wherein  
said memory includes:

15 a plurality of ROMs; and

a plurality of shift registers one-to-one  
corresponding to said plurality of ROMs,

wherein a read signal is outputted from said  
plurality of shift registers to said plurality of ROMs,  
20 in accordance with said clock signal inputted from said  
third input pad, such that information stored in said  
plurality of ROMs are serially outputted.

22. The printing head according to claim 21, wherein  
25 said converter inputs said read signal outputted from

said plurality of shift registers and generates a threshold signal for analog/digital conversion.

23. The printing head according to claim 22, wherein  
5 said converter has a reduction circuit which reduces a frequency of said read signal outputted from said plurality of shift registers.

24. The printing head according to claim 23, wherein  
10 said converter performs analog/digital conversion on said analog signal, in accordance with the frequency reduced by said reduction circuit.

25. The printing head according to claim 17, wherein  
15 said analog signal is an output from a temperature sensor which measures an internal temperature of said printing head.

26. A printing apparatus using the printing head in  
20 claim 17.

27. A head cartridge comprising:  
the printing head in claim 17; and  
an ink tank which contains ink to be supplied to  
25 said printing head.

28. A printing head which performs printing in accordance with an input print signal, comprising:

a nonvolatile memory for storing information on the condition of said printing head; and

5 output means for outputting the information stored in said memory in a serial format to outside of said printing head, by utilizing a clock signal and a latch signal used for inputting said print signal, within a period in which said print signal is inputted.

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29. The printing head according to claim 28, further comprising conversion means for converting the information on the condition of said printing head into digital data, and outputting the digital data in the  
15 serial format to outside of said printing head, by utilizing the clock signal and the latch signal used for inputting said print signal, within the period in which said print signal is inputted.

20 30. The printing head according to claim 28, wherein identification information of said printing head is stored in said nonvolatile memory.

31. The printing head according to claim 28, wherein  
25 said nonvolatile memory includes at least one of an EPROM, an EEPROM and a fuse ROM.

32. The printing head according to claim 28, wherein  
said output means outputs the information stored in said  
memory bit by bit, in synchronization with said clock  
5 signal.

33. The printing head according to claim 28, wherein  
said printing head is an ink-jet printing head which  
performs printing by discharging ink.  
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34. The printing head according to claim 33, wherein  
said printing head discharges ink by utilizing thermal  
energy, and includes a thermal energy transducer for  
generating the thermal energy to be applied to the ink.  
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35. The printing head according to claim 34, wherein  
the information on the condition of said printing head  
is information on a temperature of a portion where said  
thermal energy transducer is provided.  
20

36. A printing apparatus using the printing head in  
claim 28.

37. A head cartridge comprising:  
25 the printing head in claim 28; and